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## The Valuation of Insurance Liabilities: A Framework Based on First Principles


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## A framework based on first principles

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**Abstract.** We describe a framework for the valuation of insurance liabilities that relies on first principles in finance theory. Key features of the economic value of liabilities are its market consistency and the inclusion of the costs of financial frictions. We compare this framework to the Solvency II approach and highlight the differences.

**Keywords.** Insurance, Valuation, Financial Frictions, Market Consistency, Solvency II
**JEL codes.** G22,G32

# 1 Objective

There is widespread agreement that insurance contracts should be valued using an economic valuation standard. In particular, an economic standard has been adopted by the IFRS, Solvency II and the Swiss Solvency Test. An economic valuation standard requires that insurance contracts should be valued in a way that is consistent with financial principles. In other words: 1) valuation should be **market-consistent**, i.e. cash flows that are replicable by financial market instruments should be valued at their cost of replication, and 2) valuation should consider not only expenses but also the costs of holding the capital supporting unexpected losses. In the Solvency II framework, the latter constitute what is referred to as the **risk margin**. Concerns have been voiced regarding the size of the Solvency II risk margin. As a result, the specific calibration is currently being reviewed by EIOPA and the European Commission as well as by the PRA at the request of the UK Treasury Select Committee. This document is to be understood as a contribution to this ongoing discussion.[1]

We believe that to justify or reject any calibration the underlying theoretical framework needs to be explicitly stated. We thus aim to describe such a framework within which the valuation of insurance liabilities can be derived from first principles in finance theory. This framework is used as a benchmark against which the Solvency II approach is compared. Many of the arguments put forward in the discussion on the calibration of the risk margin do not appear to make reference to a single framework and to the best of our knowledge no such framework has been rigorously articulated.

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[1] Some of the points made in this document were also made in Huber and Kinrade (2018).

### Structure of the document

Section 2 discusses the simple set up chosen to present our ideas, introduces the notions of hedgeable and non-hedgeable risk and contains a first exploration into the provision for frictional costs. Section 3 discusses the philosophy underlying the capitalization of insurance companies in modern solvency regimes and why a market-consistent valuation of liabilities is inextricably linked to this philosophy. Section 4 describes the cost of holding capital and, in particular, the frictional costs charge. It also emphasizes the fact that return expectations by shareholders are always after tax. Section 5 compares the Solvency II framework with our framework.

### Disclaimer

This document reports on work in progress and is not in final form. Since it does not report on a standard framework we have had to introduce nonstandard terminology which may change in future versions. Moreover, the opinions expressed in this publication are those of the authors.

# 2 The set up

The principles underlying our valuation framework are best described in the simple situation of an insurance contract covering risk over one or several periods against a single premium. Such contracts give rise to a stream of cash flows consisting of future losses and costs. These cash flows can be decomposed into a **hedgeable** component that can be replicated by available financial market instruments and a **non-hedgeable** component that is uncorrelated with observed financial market prices.[2]

The value of the hedgeable component is simply the cost of setting up a hedging or replicating portfolio. We call this the **present value.** For **simple contracts**, i.e. contracts whose payoffs do not depend on financial market variables, this cost is referred to as **best estimate liabilities** and corresponds to discounting cash flows of expected claims and expenses with respect to the risk-free term structure in the underlying currency of the contract. For the remainder of this document we consider only simple contracts.

Non-hedgeable risk needs to be supported by **risk capital,** which plays the role of a buffer that ensures that policyholder's claims against the insurer can be met with a certain degree of confidence. We focus on the case where this capital is provided by shareholders exhibiting rational behavior.[3] The value of the non-hedgeable component – the cost of bearing non-hedgeable risk – corresponds to the cost of holding risk capital assuming the

[2] Under hedgeable risk we understand all financial market risks that can be hedged. In particular, we include hedgeable credit risk. Moreover, we point out that the framework assumes deep, liquid and transparent financial markets and the existence of a risk-free instrument for every maturity. In practice, this assumption is not met in its pure form. For instance, no financial contract is truly risk-free, there may not be instruments covering all maturities, the volume of available instruments may be smaller than that of outstanding insurance claims. Justified as they are, these caveats apply to any of the valuation approaches that are used in practice. In reality this leads to a situation where not all of the non-hedgeable risk is diversifiable. We will disregard these difficulties in this document.

[3] In particular, we do not consider debt financing.

insurer is not exposed to hedgeable risk.[4] The value of an insurance contract needs to cover the cost of holding capital not only for the year in which the contract was written, but also for all years in which the contract generates risk for the insurer's balance sheet. In other words, at any point in time, the **economic value** of insurance liabilities is the sum of best estimate liabilities plus the cost of holding capital for the current year plus the present value of the costs of holding capital in future years. The provision for future capital costs will be called the **frictional costs margin**. At any given year, the cost of holding capital is driven by the amount of capital held by the insurer and by the return required by shareholders.

### Required return and frictional costs margin: A first go

Note that the return required by shareholders is always on an **after-tax basis**. We split it into three components. The first component, the **base cost of capital**, corresponds to the required risk adjusted return on the asset portfolio in which the risk capital is invested. The second component, the **carrying cost of capital**, is a compensation for certain financial frictions inherent to the environment within which insurers operates, e.g. for the fact that capital may be trapped due to regulatory requirements. The final component, the **return on franchise**, represents economic profits[5] that shareholders expect to earn as new business is written.

| Required return = Base cost of capital + Carrying cost of capital + Return on franchise |
|---|

The base cost of capital, the frictional costs of capital, and the return on franchise are discussed in greater detail in Section 4 emphasizing the distinction between pre-tax and after-tax required returns. Indeed, taxes are an additional financial friction and pretax returns need to be sufficiently high to meet after-tax return expectations, i.e. each after-tax component needs to be grossed up so as to deliver the required after-tax return once taxes have been paid.

In the rest of this section, we aim to determine which part of the required return needs to be contributed by existing insurance business. While investment activities need to generate the base cost of capital in any given year, all frictions (tax and non-tax) need to be financed by the insurance business because it is the insurance business that makes it necessary to hold capital and incur those frictions. This means that the insurance business needs to generate the tax adjustment on the base cost of capital and the carrying cost of capital. Since part of the capital is used to support existing business and another to support new business written in the current year, these costs need to be allocated to existing business and to new business.

[4] The **actual** amount of capital the company needs to hold depends on both non-hedgeable and hedgeable risk. We base the value of the non-hedgeable component on the minimum amount of capital required to provide a target level of security. From an economic perspective, the cost of any additional capital resulting from assuming hedgeable risks is a cost that should be attributed to investment activities. See also item 1 at the end of Section 3.

[5] Compare Section 4.

| Asset Management | Existing Insurance Business | New Insurance Business |
|---|---|---|
| • Base cost of capital | • Allocated carrying cost of capital<br>• Tax gross up for allocated carrying cost of capital<br>• Tax gross up for base cost of capital | • Allocated carrying cost of capital<br>• Tax gross up for allocated carrying cost of capital<br>• Return on franchise<br>• Tax adjustment on return on franchise |

**Figure 1.** Who bears which part of the capital costs

We call the annual cost burden on existing insurance business **frictional costs charge**. The frictional costs charge thus includes the carrying cost of capital and corresponding tax gross up for the capital allocated to existing business as well as the tax gross up for the base cost of capital. As a result, the frictional costs margin introduced above corresponds to the present value of the frictional costs charges in future years.

# 3 Required capital and economic value of liabilities

Modern solvency regimes requires that, each year, the company holds the amount of capital needed to absorb unexpected changes in the value of assets and liabilities during the current year with a certain level of confidence. For instance, Solvency II bases capital requirements on Value-at-Risk at a 99.5% level of confidence, which corresponds to limiting the probability of default to 0.5%.[6] If the company has sufficient capital after losses materialize, then this capital can be used to support unexpected losses the following year. Otherwise, i.e. in the presence of an **extreme loss**, the company needs to raise new capital.[7] Hence, a key question is whether after an extreme loss the insurer will be able to raise new capital or sell the business to a sufficiently capitalized entity, i.e. whether the business remains sufficiently attractive from an investor's perspective. This question can only be answered by looking at the company from a market-consistent basis because this is the basis that will be used by prospective investors to assess whether recapitalization is economically attractive.

A company whose shares are traded in the stock market and which has insufficient capital is attractive if it has a positive market capitalization[8] [9]or, equivalently, a positive share price:

[6] Other solvency regimes, such as the Swiss Solvency Test, set capital requirements based on Expected Shortfall rather than Value-at-Risk.

[7] Compared to requiring that an insurance company holds sufficient capital to ensure that, at all times, liabilities can be met with a certain level of confidence over their remaining, this approach significantly reduces the cost of providing insurance. This is because the company needs to service only the cost for the capital required to support unexpected losses during the current year.

[8] The market capitalization is the share price multiplied by the number of outstanding shares.

[9] For ease of exposition we ignore here any impact of the default option owned by shareholders as a result of the limited liability of the company.

The positive share price means that it is worthwhile for investors to buy the company which implies its recapitalization. An operational way to achieve this, which also works for non-listed companies and subsidiaries of financial groups, is to estimate the return that future capital providers will require to invest in the company and to ensure that available funds suffice to cover best estimate liabilities and the return required by prospective shareholders. As a consequence, liabilities need to be valued as the sum of a best estimates liabilities and a margin to ensure that, following an extreme loss, the company remains attractive for investors. As already mentioned in Section 2 this margin needs to provide for the frictional costs charges incurred on capital in future years and is called the frictional costs margin.[10]

### Two critical assumptions

Determining the frictional costs margin requires making certain assumptions about the company strategy in future years. We highlight two critical assumptions: future investment strategy and future target capitalization:

1. **Future investment strategy**. At any point in time, the amount of capital to be held will depend on the exposure to hedgeable and non-hedgeable risk. Hence, it is necessary to specify whether the company will assume hedgeable risk or not. The typical assumption is that it will not be exposed to hedgeable risk[11]. This is reasonable given that, in contrast to non-hedgeable risks, the decision to assume hedgeable risk is opportunistic and can typically be reverted immediately. Hence, only non-hedgeable risk needs to be considered when determining the frictional costs margin. This is in line with Solvency II.
2. **Future target capitalization**. Another key assumption refers to the target capitalization in future years. A typical target capitalization for a going concern company is 150% to 200% of the regulatory minimum. From a shareholder perspective, such a company needs to set up a frictional costs provision assuming that future capitalization will be at that level. Doing anything else would mean that the margin does not suffice to release the required returns in future years. Regulators, on the other hand, may choose to focus on the ability to transfer liabilities to a **reference undertaking**. Hence, the frictional costs margin from a regulatory perspective may differ significantly from the one from a shareholder perspective. In Solvency II, the underlying assumption is that the reference undertaking will not write new business and that it will operate with capital at the regulatory minimum.

We emphasize that the difference between the regulatory and the shareholder perspective described in item 2 is only a difference in assumptions but not on the underlying valuation principles.

[10] Strictly speaking this provision should cover not only the costs associated with **holding** capital but also those associated with **raising** capital, which can be considerable and include due diligence, lawyers, bankers, etc.

[11] In this document we disregard items such as the Matching Adjustment, which constitute a deviation from this assumption.

# 4 Base cost of capital and frictional costs margin

Capital in an insurance company is simultaneously put to two productive uses. On the one hand, it is invested in financial assets and earns an investment return and, on the other hand, it used as a buffer to absorb unexpected losses.

### Taxes and required returns

An important ingredient in all further considerations is corporate taxes. Keeping track of what is pretax and what is after tax is cumbersome but essential to get things right. There are two basic observations. First, return expectations of shareholders are **always** after-tax return expectation and, second, returns to shareholders **not** recognized as an expense in the tax account and are therefore taxed. This means that whenever after-tax return expectations are included in the valuation of liabilities, they need to be grossed up to reflect the fact that they will be taxed.

### The base cost of capital and the double-taxation charge

As their capital is invested in financial assets, shareholders will require an investment return that is commensurate with the riskiness of the investment portfolio and which we call the **base cost of capital**. For a company that is not exposed to hedgeable risk – because it has replicated the expected claims and expenses and invested its capital in risk-free instruments — the base cost of capital is precisely the risk-free rate. However, the base cost of capital increases with increasing hedgeable risk since riskier strategies require an expected return that is higher than the risk-free rate.

Even if the insurance company manages to generate the base cost of capital through its investment activities, shareholders will not receive all of it because part of it will be taxed as corporate income. Hence, for the insurance company to be able to generate the base cost of capital on an after-tax basis, it needs to compensate for taxation: The pretax return needs to be sufficiently high to match, after-taxes have been paid, the base cost of capital. Note that an insurer cannot expect to generate this additional pretax return by taking more financial market risk. Indeed, as already pointed out, taking more financial market risk only increases the base cost of capital.[12] The compensation for taxation, which we call the **double-taxation charge,**[13] can only be earned by having policyholders pay for it through premiums.

### The irrelevance of insurance risk for required returns

As we have already mentioned, capital is also used as a buffer to absorb negative realizations of the non-hedgeable component. Do shareholders require an additional return for this use? This is one of the most debated questions about insurance valuation.

[12] The compensation for the tax loss could, in principle, also be earned by generating investment returns that outperform the base cost of capital on a risk-adjusted basis. Assuming that financial markets are approximately efficient this does not appear realistic.

[13] The term double taxation is used because investment returns are taxed twice; first, as corporate taxes and, second, as shareholders' private income taxes.

Finance theory argues that shareholders do not require an additional return because, by holding a small portion of their wealth in the shares of the insurance company, they can diversify away non-hedgeable risk.[14] Since investors have the ability to virtually eliminate this risk, the market does not provide compensation for bearing it. This is typically expressed as "there is no risk premium for **idiosyncratic risk".**[15] This would mean that the after-tax return required by shareholders is limited to the base cost of capital and any return above it constitutes **value added** or **economic profit**. There are, however additional considerations that need to be accounted for: financial frictions and economic profit expectations.

### Financial frictions other than double taxation

One can view the double-taxation charge as compensating shareholders for a financial friction that reduces the return of financial assets when they are held within a tax-paying corporation. But there are also other, well-documented, financial frictions in addition to double taxation.[16] These include agency costs (arising from the inherent conflict of interest between shareholders and company's managers), cost associated with regulatory restrictions related to the ability to reclaim capital, costs related to the loss of value in financial distress, etc. In order to be compensated for these items, shareholders require an after-tax return **over and above** the base cost of capital, which we call the **carrying cost of capital**. After grossing this cost component up for taxes we obtain the **pretax carrying cost of capital**. Similarly to the double-taxation charge, the pretax carrying cost of capital needs to be funded from premiums. The sum of the double-taxation charge and the pretax carrying cost of capital will be called the **frictional costs charge**.

### The indifference return

From what we have said above we conclude that, for shareholders to be indifferent between putting their capital to work in an insurance company and investing it directly in financial markets, the insurance company needs to generate a pretax required return that is equal to the base cost of capital plus the frictional costs charge. We call this return the **indifference return**. Any return that is generated over and above the indifference return constitutes **economic profit** or **value added**.

**The frictional costs charge is not a risk premium**

It is important to note that, from a finance theory perspective, the frictional costs charge does not constitute a **risk premium** for non-hedgeable risk that is diversifiable. In finance theory, there is no additional return requirement for non-hedgeable risk. However, the capital that insurers actually hold is subject to the costs of double taxation and other financial frictions. It is these costs that make bearing non-hedgeable risk costly for an

[14] In light of the assumptions described in Footnote 2, we have ruled out undiversifiable non-hedgeable risk (e.g. reinvestment risk).

[15] Note that this has to do with the **investor**'s ability to diversify and not with the **company** holding a diversified portfolio.

[16] See Harrington and Niehaus (2004) and Hancock et al (2001) and the references therein.

insurer.[17] As a result, it is not the amount of non-hedgeable **risk** that determines the additional return requirements; it is the amount of **capital** that a company actually holds.

### The economic value of liabilities revisited

In Section 3 we have determined the economic value of liabilities to be the best estimate liabilities plus a frictional costs margin. The discussion above shows that the frictional costs margin corresponds to the present value of frictional costs charges for the entire lifetime of the contract. The frictional costs margin decreases year by year as the frictional costs charge is released through the corporate income statement and taxed. The amount that is released is precisely what is required to meet shareholders' after-tax return expectations.[18]

### Economic profits and franchise value

In light of the above discussion, **economic profits** correspond to any after-tax return **above** the indifference return. If, in expectation, the insurance company can only generate the indifference return, the company is not generating economic profits and investors will value it at its **economic net worth**, i.e. at the net of the economic value of assets and the economic value of liabilities. This means that its **market capitalization**, i.e. the share price times the number of outstanding shares, will be equal to its economic net worth. A company that continues to write profitable new business will be expected to generate economic profits year after year and its market capitalization should be higher than economic net worth. This means that when investors buy a share of the company they are buying not only its economic net worth, but also its potential to generate future economic profits. The difference between the market capitalization and economic net worth corresponds to the value attached by investors to the expected future economic profits and is called the **franchise value** of the company.[19] Of course, it is also possible that a company is expected to be systematically unable to generate the indifference return. In this case, the market capitalization of the company will be lower than its economic net worth and its franchise value will be negative.[20]

[17] Froot and Stein (1998) and Froot (2007) show that in the presence of frictional costs, the cost of bearing non-hedgeable risk depends on whose balance sheet it is on.

[18] The taxation of the margin for frictions is slightly more subtle. The tax value of insurance liabilities differs from what we have described because it typically does not allow for the margin for frictions. This is a temporary difference that results in a deferred tax asset in the financial statements. Note that Solvency II statements also allow for this deferred tax asset.

[19] In the corporate finance literature, Myers (1977) was among the first to formally distinguish the market value of the firm into assets in place and investment opportunities. The franchise value, which represents generically future economic rents and growth opportunities, is known also as charter value in the banking literature (e.g. Herring and Vankudre (1987), Keeley (1990)) and as the growth-option value in the asset pricing and corporate finance literature (e.g. Berk et al. (1999), Carlson et al. (2004), Cooper (2006)). To empirically gauge the magnitude of the franchise value, researchers have widely resorted to Tobin's q (e.g. Lindenberg and Ross (1981), Hayashi (1982), Bolton et al. (2011)), the book-to-market value ratio (e.g. Smith and Watts (1992), Berk et al. (1999)) and idiosyncratic volatility (e.g. Cao et al. (2008), Da et al. (2012)). However, these measures have been typically applied only to non-financial institutions.

[20] Recall that, for ease of exposition, we have omitted an important component of company value in this account. In addition to economic net worth and franchise value the market capitalization includes the value of the option to default shareholders own as a result of the limited liability of the company.

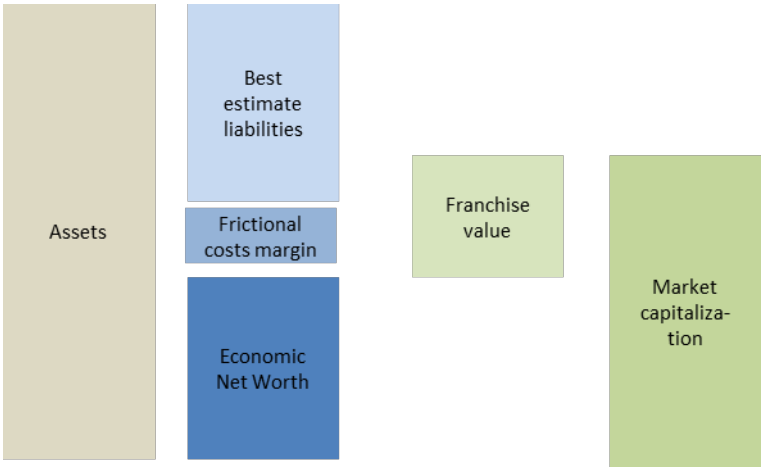


**Figure 2**. Company balance sheet and market capitalization (simplified)

As a result, to justify a given market capitalization, every year, the pretax return of the insurer needs to cover not only the base-cost of capital and any frictional costs charge, but also the economic profit expectations for the year. Note that the economic profit margin and the corresponding tax gross up is generated in the moment new business is written and is "immediately" added to net worth.

**The cost of capital in a CAPM framework**

The CAPM is the most widely used model for the determination of the required return by the shareholders of a company[21]. We highlight three key aspects of the CAPM cost of capital:

1. As an estimate of the required return on the market capitalization of a company, it represents an after-tax return benchmark. Hence, any pretax required return benchmark derived from the CAPM needs to be adjusted (increased) to allow for tax.
2. As a return on the market capitalization of a company, it includes the return on franchise, which corresponds to an economic profit target implied by the current market capitalization. Hence, deriving the required return benchmark for a company that will not write new business can be done by adjusting (downward) the required return benchmark for a company that does write new business so as to reflect a zero franchise.[22]
3. In the CAPM framework systematic risk is captured by β and required return is expressed as the risk-free rate plus β times the risk premium for systematic risk. Hence, β includes risk attributable to the base cost of capital. Since the base cost is not reserved

[21] In the asset pricing literature, there exists a number of anomalies related to the differences between realized average returns associated with certain characteristics of securities (or portfolios) and the returns that are predicted by a particular asset pricing model (Brennan, Xia (2001)). Two prominent anomalies with respect to the predictions of the CAPM are those related to the firm size and to the book-to-market value ratio, which refer to the apparent abnormal returns on small-size and on high book-to-market value ratio stocks, respectively (Fama and French (1993), Fama and French (1996), Fama and French (1998)).

[22] The return on franchise is related to the book-to-market value ratio anomaly because it represents the incremental return that is typically commanded by growth stocks (i.e. stocks of firms with high growth opportunities and hence low book-to-market value ratios). Recognizing that stock returns may reflect the value of growth options on the underlying firm, Duo, Ga and Jagannathan (2012) develop and test a simple model in which realized returns and CAPM-based returns are reconciled after extracting the return on franchise from estimated realized returns.

for in the fictional costs charge, the impact of the investment strategy of the company needs to be stripped out.

4. In the CAPM framework, no additional return is required for nonsystematic risk. In particular, the risk premium for non-hedgeable risk is zero.

# 5 The Solvency II risk margin

In the context of Solvency II, the **value of liabilities** is given by best estimate liabilities plus the **risk margin**. In the framework we have described above, the risk margin can only correspond to the margin for frictions of the reference undertaking that is assumed to receive the liabilities. There are, however, important ways in which the Solvency II risk margin differs from our margin for frictions:[23]

1. The margin for frictions depends on the projected levels of actual capital held by the company. On the other hand, the Solvency II risk margin only reserves for capital at 100% of Solvency II required capital, assuming that the reference undertaking receiving the liabilities will operate at that level of capitalization.

2. The calibration of the Solvency II risk margin relies on the CAPM and applies a downward adjustment to the risk premium (β times the market risk premium) to not include the franchise value embedded in market prices. However, since part of the risk premium is due to the investment risk the company assumes, part of the base cost of capital is being included in the risk margin.

3. Despite the fact that an upward adjustment is applied the risk premium to reflect some frictional costs (e.g. double taxation), there exists no quantitative assessment of the effective aggregate effect of both upward and downward adjustments.

4. The Solvency II risk margin is a pretax charge.[24] This means that the 6% cost of capital rate reflects a pretax spread. However, the risk margin was calibrated on an after-tax basis using a CAPM approach (see footnote 12 for the reference CEIOPS's document).[25]

As a result there are certain aspects of the Solvency II risk margin that require further scrutiny:

1. The assumption that liabilities are received by a reference undertaking operating at 100% of Solvency capital seems unrealistic unless such an undertaking were given special dispensation to operate below 100% of Solvency II requirements. Otherwise, they would at least require an operational buffer to avoid having to recapitalize too frequently.[26]

[23] The remarks below refer to the calibration of the Solvency II risk margin as in CEIOPS's (2009) "Final CEIOPS' Advice for Level 2 Implementing Measures on Solvency II: Technical Provisions – Article 86 (d) Calculation of the Risk Margin (former CP 42)".

[24] This is acknowledged by treating the risk margin as a temporary difference that is reflected in the deferred tax calculation in the Solvency II statements.

[25] It is worth noting that part of the insurance literature has focused on the estimation of the insurers' cost of capital. From early studies (Lee and Forbes (1980, Harrington (1983)) to more recent papers (Cummins and Phillips (2005), Wen et al (2008), Barinov et al. (2018)), a variety of methods has been applied, including the standard CAPM, its conditional and intertemporal versions, APT, Fama-French factor models and the full-information Beta. However, none of these studies has attempted to differentiate between the base cost of capital, the frictional cost of capital and the return of franchise.

[26] As mentioned before (see Footnote 11), there are considerable costs associated with raising new capital.

2. Even if the risk margin were sufficient to attract new capital to set up a company that runs the liabilities off and operates at 100% Solvency II capital, it is unlikely to suffice for the actual company currently holding the liabilities, since its target capitalization will typically be above the regulatory minimum. Hence, from the perspective of the current shareholders, the capital base on which the risk margin in Solvency II is calculated should be perceived as being rather on the low side.
3. Assuming a tax rate of 25%, the 6% rate used to compute the Solvency II risk margin should be compared with a post-tax CAPM spread in the range of:
   - 2.7% to 3%, if we assume a target Solvency II capitalization of 150%.
   - 3.3% to 3.75, if we assume a target Solvency II capitalization of 120%.
   - 4% to 5%, if we assume a target Solvency II capitalization of 100%.

### Conclusion and outlook

It follows that the Solvency II risk margin deviates in important ways from the framework described in this document. However, while correcting for some of these deviations would decrease the risk margin, correcting for others would increase it. Although difficult to quantify precisely at this stage, it is likely that the net impact would be an increase. It seems important to further investigate a calibration of the risk margin that is in line with the principles laid down in this document. To this effect, much works still needs to be done on understanding and calibrating the various required return components. This is the subject of ongoing work.

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